Impact of private health insurance on a public healthcare system: the case of cesarean deliveries

Carine Milcent, Saad Zbiri

PARIS SCHOOL OF ECONOMICS
ECOLE D'ECONOMIE DE PARIS

WORKING PAPER N° 2018 – 52

Impact of private health insurance on a public healthcare system: the case of cesarean deliveries

Carine Milcent
Saad Zbiri

JEL Codes: I11, I18
Keywords: Private health insurance; Public healthcare system; Activity-based payment; Cesarean delivery

PARIS-JOURDAN SCIENCES ECONOMIQUES
48, BD JOURDAN – E.N.S. – 75014 PARIS
TÉL. : 33(0) 1 80 52 16 00=
www.pse.ens.fr

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE – ECOLE DES HAUTES ETUDES EN SCIENCES SOCIALES
ÉCOLE DES PONTS PARISTECH – ECOLE NORMALE SUPÉRIEURE
INSTITUT NATIONAL DE LA RECHERCHE AGRONOMIQUE – UNIVERSITE PARIS 1

Impact of private health insurance on a public healthcare system: the case of cesarean deliveries.

Carine MILCENT[‡] and Saad ZBIRI[§]

September 2018

Abstract

According to the health economics literature, medical practices respond to the source of hospital payments and the rules that govern them. Here, we study the impact of supplementary private health insurance within the DRG-based financing of French hospitals. We use differences between the public and private hospital sectors in managers' and doctors' incentives (in terms of potential additional payments) and examine their effect on the practice of cesarean deliveries. We mobilize exhaustive delivery data from a French district over a 7-year period (2008-2014) and consider factors that are known to influence obstetric practices. Our empirical results show that, although private hospitals are financed by a single public payer, like those in the public sector, they perform significantly more cesarean deliveries than public hospitals. This result is explained by additional payments covered by private health insurance and charged by private but not public hospitals.

JEL classification: I11, I18

Keywords: Private health insurance; Public healthcare system; Activity-based payment; Cesarean delivery;

[*] We thank Patrick Rozenberg for access to data and helpful support. Thanks also to the seminar participants at the 36th meeting of French health economists, the first Oxford international health conference, and the 23rd conference of Italian health economists for their useful comments.

[‡] Paris-Jourdan Sciences Economiques, French National Center for Scientific Research, Paris, France. E-mail address: carine.milcent@psemail.eu

[§] EA 7285, Versailles Saint Quentin University, Montigny-le-Bretonneux, France. E-mail address: saad.zbiri3@uvsq.fr

1. Introduction

Activity-based payment using diagnosis-related groups (DRGs) is now used in most developed countries. All French hospitals, public and private, are publicly paid through a DRG-based[1] prospective payment system, introduced in 2008. Here, we investigate the impact of private health insurance on a hospital healthcare system where both public and private sectors are publicly, and apparently similarly, funded.

What we are looking at in this study is appropriateness of cesarean deliveries. Like previous papers on cost efficiency and hospital performance (Hafsteinsdottir and Siciliani, 2010), we examine the argument of efficiency. The literature, both theoretical and empirical, has examined the overall effect of activity-based payment. Although convincing theoretical arguments lead to expectations of hospital cost reductions and improved efficiency, the empirical evidence is inconclusive. The introduction of the DRG system was associated with positive effects on hospital efficiency in Finland (Linna, 1999), Portugal (Dismuke and Sena, 1999), Norway (Biørn *et al.*, 2003; Biørn *et al.*, 2010), and Switzerland (Widmer, 2015), while no such effects were found for Germany (Herwartz and Strumann, 2014), Italy (Barbetta *et al.*, 2007), Austria (Sommersguter-Reichmann, 2000), or the United States (Borden, 1988; Chern and Wan, 2000).

In public hospitals, France has a model where hospitals are in competition but physicians are salaried. In private hospitals, both hospitals and their physicians are paid according to their level of activity, but also receive additional payments from private health insurance. This raises the questions of doctors' profit-oriented practices. Baker *et al.* (2014) examined the consequences of contractual or ownership relations between hospitals and physician practices, often described as vertical integration. They found that "an increase in the market share of hospitals with the tightest vertically integrated relationship with physicians — ownership of physician's practices — is associated with higher hospital prices and spending." A systematic review examining the factors explaining the diversity of findings regarding hospital ownership and quality (Eggleston *et al.*, 2008) reports that the diverse results in the hospital ownership literature can largely be explained by differences in institutional context, including differences across regions and markets, and over time.

[1] A specific DRG classification was set up in France. For simplicity's sake, the term "DRG" will be used as a generic term that includes the French classification.

Most empirical work on the effect of reimbursement rules on healthcare production uses U.S. data (see Sloan, 2000, for a review). However, the structure of the U.S. healthcare market makes it hard to disentangle the pure effect of hospital ownership from other institutional features such as the segmentation of insurance or payers and payment types (Lien *et al*., 2008). In France, the national health insurance system (*Sécurité Sociale*) is a single-payer system that covers the entire population. Studying the French context usefully eliminates any concern about, on the supply side, different reimbursement schemes for different payers, negotiation between providers and payers, and cost-shifting behavior by providers, and on the demand side, financial access to hospitals.

Controlling for relevant patient- and hospital-level characteristics, we find that private hospitals perform more cesarean deliveries than public-sector hospitals. This result is explained by the context. Both sectors are publicly funded, but in the private sector both institutions and doctors receive additional payment from private health insurance for charges that public hospitals are not allowed to bill.

In the following section, we briefly outline the factors that determine the use of cesarean deliveries and the characteristics of French hospitals providing obstetric services. The third section describes the data used for this study and offers some preliminary statistics. The econometric strategy is presented in the fourth section, and the results and robustness checks are reported in the fifth. In the sixth, we discuss the results and conclude.

2. Cesarean delivery and the French healthcare system

2.1. Use of cesarean deliveries

Cesarean delivery is one of the most common surgical operations around the world (Gibbons *et al.*, 2012). Epidemiologic studies show a negative association between cesarean rates and maternal, neonatal, and infant morbidity and mortality (Althabe *et al.*, 2006; Villar *et al.*, 2007). This type of delivery may provide psychological and social well-being (Mazzoni *et al.*, 2011). However, it can also cause significant and sometimes permanent complications, disability, or death (Hyde and Modi, 2012; Souza *et al.*, 2010). It is also associated with a higher cost (Allen *et al.*, 2005; Rogers *et al.*, 2017). It should thus be undertaken only when medically necessary. The research literature identifies many interrelated factors that influence

the number of cesarean deliveries. These are related to the characteristics of women, medical staff, and hospitals.

Women's characteristics explain cesarean deliveries in part. Older women and those having their first child have a higher probability of cesarean deliveries (Cleary R *et al.*, 1996; Ecker *et al.*, 2001). The presence of some medical risk factors for the woman and/or her fetus, which may arise from conditions that existed before pregnancy (e.g., chronic diseases), or develop during pregnancy (e.g., eclampsia), or labor (e.g., dystocia), are associated with more frequent cesarean births (Menacker *et al.*, 2006; Penn and Ghaem-Maghami, 2001). Further, women of lower socioeconomic status have a higher probability of cesarean delivery than their more socioeconomically advantaged counterparts, at least in high-income countries (Linton *et al.*, 2004; Milcent and Zbiri, 2018). The choice of the woman herself may also be a factor (Mazzoni *et al.*, 2011).

The apparent increased use of "defensive medicine" in obstetrics is likely to contribute to the increase in cesarean deliveries. Many studies find a positive correlation between higher cesarean rates and the increase in obstetricians' perceived risk of complaints and litigation (Fuglenes *et al.*, 2009) or in their malpractice insurance premiums (Dubay *et al.*, 1999; Yang *et al.*, 2009).

The time required for a cesarean is relatively stable while the time required for a vaginal delivery is unpredictable. Cesarean deliveries thus make it easier to manage medical equipment and facilities as well as physicians' time. Analyses show that the probability of a cesarean delivery increases sharply on Friday evenings and decreases during the weekend as physicians factor their time off into their medical practices (Brown, 1996; Fabbri, 2008).

Heterogeneity of delivery practices may also be explained in part by hospital characteristics. Studies report an increased likelihood of cesarean deliveries for highly-equipped hospitals (Le Ray *et al.*, 2006), as well as for teaching hospitals (Hammond, 2015). Hospital organization also plays a role: the probability of a cesarean delivery is lower in hospitals where obstetricians are more available (Yee *et al*., 2017). The size of the maternity unit also affects the probability of cesarean delivery in various ways (Roman *et al*., 2008; David *et al*., 2001). Staff organization in hospitals also has an impact (Milcent and Rochut, 2009).

Finally, reimbursement rules affect the cesarean delivery rate. Gruber and Owings (1996) report that, after a drop in the birth rate in some U.S. states, the number of cesarean deliveries increased. Gruber *et al.* (1999) show that a significant pay gap between a cesarean and a vaginal delivery accounts for half of the differences in practices in the U.S. Using the data from Gruber *et al.*, Grant (2009) confirms the effect of physicians' financial incentives on cesarean rates. In France, Milcent and Rochut (2009), using data from before implementation of the activity-based payment, show that private for-profit hospitals performed substantially more cesarean deliveries than public sector hospitals. This disparity was attributed to the difference in hospital payment systems. This context has changed: all French hospitals are now governed by the same reimbursement rules for all acute care stays, including for childbirth.

2.2. Hospital sector and obstetric care in France

In the French hospital healthcare system, there is a single payer: the national health insurance funds (*Sécurité Sociale*). The public system sets its own fee schedule. Computation of its fees include some costs, such as doctors' salaries, that are absent for the private sector.[2] As a result, there are two fee scales according to sector, presumably close to equivalent after the private obstetrician bills the patient separately for his or her services. Table 1 presents the fee as a function of the hospital sector, for the first and last years of the study period. We observe that the mean DRG fee for delivery is around 2,500 Euros. The fee is around 40% higher for a cesarean than a vaginal delivery, and the difference in their fees is quite similar regardless of sector. Hence, the same financial incentives govern the provision of childbirth services in both sectors.

On the patient side, all households are compulsorily enrolled in this public health insurance, which is financed by deductions (or for the self-employed, mandatory contributions) of a percentage of income. In-patient obstetric services (delivery) are reimbursed at 100% of the fee, regardless of hospital sector. For those few people not otherwise covered because no one in the household is working, a special health insurance system ensures equivalent 100% coverage for childbirth. Therefore, the healthcare reimbursement for admittance in both public and private hospitals comes from this single public health insurer.

[2] In the public sector, the doctor's wages are based on the civil servant grid, while in the private sector, independent physicians work on a fee-for-service basis, charging their patients directly.

Nonetheless, the situation is somewhat more complex. Only in private hospitals, patients can be charged additional fees for: (1) room and board, and (2) physicians' fees. Private supplementary health insurance reimburses most of these additional fees, and 95% of the French population has such private insurance (Ministry of Health, 2016).

The room and board fees may be substantial in private hospitals. They are around 60 to 100 Euros for a one-night stay and may thus encourage medical practices that maximize length of stay. Cesareans require longer hospitalizations than vaginal deliveries. A private hospital thus has an additional incentive to perform more cesarean deliveries.

Hospital sector also affects physicians' income. In the public sector, hospitals compete both within and across sectors. On the other hand, medical staff and doctors are salaried. Their volume of work activity does not affect their income. As a result, the doctor's choice of procedure is not influenced by income considerations. The doctor is a brake on the push to volumes. In the private sector, physicians bill mainly on a fee-for-service basis. They receive their payment from the institution as well as from the woman herself *via* additional fees. These supplementary fees vary from 50 to 2,700 Euros, and average from 200 to 300 Euros for a vaginal delivery and from 500 to 600 Euros for a cesarean delivery. For anesthetists, it is about 200 Euros.[3] As in the U.S., both the doctor and the hospital administration in the French private sector have incentives to increase the volume of cesarean deliveries.

There may also be some non-financial incentives. In public hospitals, women cannot choose their physician. The woman is assigned to a hospital but not to one obstetrician. During her pregnancy, a woman may see different physicians or even only or mainly midwives for her prenatal care visits. In a private hospital, however, she chooses a specific obstetrician who generally sees her for all of her prenatal care and delivery. The patient-physician relationship is thus closer, which increases the likelihood that the obstetrician will satisfy the woman's requests for delivery. Moreover, their ability to control their schedule (and keep evenings and weekends free) provides further incentives for cesarean birth for obstetricians at private hospitals.

They are also more likely to practice defensive medicine, and cesarean deliveries may reduce malpractice liability because they reduce the risk of complications during delivery. More important, physicians at public hospitals are covered by the hospitals' malpractice liability

[3] Unpublished mutual insurance data from 2011, the only known reference in France.

insurance, while independent physicians in private hospitals must purchase their own malpractice insurance. This may be an incentive to perform more planned cesarean deliveries, in which the medical risk is lowest.

3. Data and preliminary statistics

We use exclusive French data that allow us to consider the factors that influence cesarean deliveries, including *i)* the woman's age and medical risk factors, *ii)* her household's socioeconomic situation, *iii)* hospital characteristics, including sector and the organization of the maternity unit.

3.1. Exhaustive delivery data

We mobilize data from deliveries in 2008 through 2014 from two databases. One database contains all deliveries in the Yvelines administrative district. The second database contains information about all French hospitals.

The first database comes from the first health certificate (*Premier Certificat de Santé*, PCS) of infants born in the district. In France, the PCS certificate is completed for each newborn before discharge from the maternity unit. In the Yvelines, it is supplemented by additional data concerning topics such as household deprivation, severe morbidity, and delivery trauma. The PCS database contains demographic information about the woman: age and parity;[4] detailed information about her individual socioeconomic level and that of her partner: status of the couple, level of education, occupation, and employment/labor force status; information about the pregnancy: medical follow-up, hospital stays; information about the delivery: hospital, date, mode of delivery, and delivery procedures performed; and full information about maternal, fetal, and neonatal health: diagnoses and co-morbidities. The study includes all births in the Yvelines district during the complete calendar years from 2008 through 2014, but excludes deliveries that are stillbirths, medically indicated terminations of pregnancies, and births that occurred outside maternity units. The study sample thus comprises 102,236 deliveries, for 58,645 of which full socioeconomic data are available. Because this information on socioeconomic characteristics is quite important, we analyze all observations with complete socioeconomic data. However, as a robustness check, we also re-estimated all

[4] Here, parity is the number of previous deliveries; nulliparous women are having their first child.

our results with the full sample of all observations.[5] The PCS database is processed by the general council of Yvelines (*Conseil départemental des Yvelines*), in collaboration with the regional public health administration agency (*Agence Régionale de Santé de l'Ile-de-France*), and the local perinatal network (*Réseau Périnatal Maternités en Yvelines et Périnatalité Active*). All data used are reported to the French data protection authority (*Commission Nationale de l'Informatique et des Libertés*, CNIL, number 1295794). The PCS certificate is completed, almost prospectively from birth, by midwives and physicians. The contents of the certificates are also double-checked to correct inaccurate and missing information. The information extracted is thus of high quality.

The second database is the French annual statistics for hospitals (*Statistique Annuelle des Etablissements de santé*, SAE). This survey, conducted by the Ministry of Health, provides information on all hospitals including their status, equipment level, volume of activity, medical staff composition, and location. The information on hospitals with obstetric care in the Yvelines district was located, checked, and supplemented through data from the local perinatal network.

3.2. Descriptive statistics

3.2.1. The French district of Yvelines

Yvelines is the eighth largest administrative district in France by population (French national institute of statistics (*Institut National de la Statistique et des Etudes Economiques*, INSEE), 2008-2014 data). Table A1 presents the summary statistics for patient- and hospital-level characteristics of the women giving birth in the district in 2008-2014. Their mean age is 30.7 years, and 43.1% of them are nulliparous. The most frequent medical risk factors for cesarean delivery are induced labor, previous cesarean, and other obstetric pathology,[6] which account, respectively, for 21.6%, 10.3%, and 7.1% of all women.

The Yvelines district has some geographic disparities in its socioeconomic status. The eastern Yvelines is made up of middle-class and upper-class areas. The rest is composed of an extensive rural zone with sparsely distributed, high-income areas, and some quite low-income

[5] See more details on the robustness checks in Section 5.4.
[6] The "other obstetric pathology" variable includes the diagnoses and co-morbidities not already considered individually (previous cesarean, diabetes, hypertension, eclampsia, and preeclampsia, intrauterine growth restriction, and placental disorder are all individual variables), that is, for example, infection, premature rupture of membranes, obesity, or amniotic fluid abnormality.

areas (INSEE, 2008-2014 data). As Table A1 shows, few women have no partner (2%). The majority of women (61.4%) have a post-secondary education.[7] Most women and their partners work, 69.6% and 89.8%, respectively, versus 6.7% and 4.4% who are unemployed, and 23.7% and 5.8% who are not in the labor force.[8] Differences also exist in occupations. Both the women and their partners work most often in office, sales, and service occupations, respectively 55.2% and 40.1%, and in second place, as managers and in higher intellectual occupations, respectively 31% and 36.7%.

The Yvelines administrative district is well served by healthcare facilities providing obstetric care. From 2008 through 2014, the number of deliveries is stable. In this district, 66.4% of deliveries take place in public hospitals and 33.6% in private hospitals. All private hospitals in the Yvelines are private for-profit hospitals. The distribution of births by sector is similar to the nationwide distribution.[9] Maternity units without special neonatal care (equipment level 1, with the least equipment) account for 19.1% of deliveries, versus 39.6% and 41.3%, respectively, for hospitals with special and intensive neonatal care units. Moreover, university hospitals perform 37.5% of the deliveries in the district.

The Yvelines has an average cesarean rate of 23.9% for the study period, higher than the national rate of 20.3% during the same period (SAE, 2008-2014 data). The Yvelines cesarean rate is lower in the public (22.3%) than in the private sector (27.2%). From 2008 to 2014, the overall rate is relatively stable. However, it decreases in public hospitals by 9.3% while it increases by 13.9% in private hospitals.

3.2.2. Public versus private hospitals

Population characteristics vary notably by hospital sector (Table A1). Women giving birth in private hospitals are older than those in public hospitals, 31.5 years versus 30.3 years. Nonetheless, public hospitals provide care for a population considered to be at higher risk than those in private hospitals. For example, 4.3% of women giving birth in public hospitals have diabetes versus 3.3% of those admitted to private hospitals.

[7] In contrast to those with some secondary school, women who completed secondary education have reached the final year of secondary school, whether or not they obtained the baccalaureate degree.
[8] Those not in the labor force include students, apprentices, homemakers, retirees, those on parental leave, and others neither working nor looking for work.
[9] In France, 66% and 34% of the deliveries were performed in public and private hospitals, respectively (SAE, 2008-2014 data).

Similarly, the economic level of households affects the sector: the percentages of low-educated, low-skilled, and non-working women are all higher in public than in private hospitals, respectively, 42.8% versus 30.5%, 60.4% versus 49.3%, and 32.8% versus 25.5%. The same disparities appear for the partners: in public hospitals, 55.7% and 11.7% of parturients' partners are, respectively, low-skilled and not working, compared with 39.3% and 11.7%, in private hospitals.

Comparing equipment level by sector, we observe that the majority of births in public hospitals take place in high-equipped maternity units with neonatal intensive care (62.2%), while in private hospitals women most often give birth in maternity units with special neonatal care (60%). Note that all hospitals with neonatal intensive care and all those that are teaching hospitals are public.[10]

Finally, focusing on organizational factors, we see that public hospitals have a higher rate of births on non-working days including weekends and holidays than private hospitals, 27.9% versus 23.5%.

4. Econometric strategy

The empirical analysis uses panel data to assess the effect of the hospital sector on the practice of cesarean deliveries.

A simplified way of writing the basic model we set up is as follows:

$$P(Y) = f(T, D, X, S, W, V, e)$$

with Y equal to 1 if patient i in hospital j in year t has a cesarean.

- T_t is a linear continuous time variable (trend), starting in 2008 (trend=0) and ending in 2014 (trend=6);

- D_{ijt} is the set of variables of demographic characteristics for patient i in hospital j in year t: age and parity;

[10] In France, the hospitals with neonatal intensive care unit are all in the public sector. Moreover, any institution with an intensive care unit would be required to accept emergency cases, which might explain the absence of any private neonatal intensive care unit.

- X_{ijt} is the set of medical risk factors of woman i in hospital j in year t such that one of them justifies or favors performing a cesarean delivery: previous cesarean, diabetes, hypertension, eclampsia or preeclampsia (including HELLP syndrome), intrauterine growth restriction, placental disorder (including placenta previa, placenta accreta, and abruptio placenta), other obstetric pathology (such as obesity, infection, premature rupture of membranes, amniotic fluid abnormality, or congenital anomaly), preterm delivery (gestational age < 37 weeks), post-term delivery (gestational age > 41 weeks), fetal breech presentation or transverse lie, induced labor, low birth weight (< 2500 grams), and high birth weight (> 4000 grams);

- S_{ijt} is the set of variables for socioeconomic characteristics for patient i in hospital j in year t: status of the couple, level of education, type of occupation, and work status of the woman, and her partner's type of occupation and work status;

- W_{jt} is the set of hospital type variables for hospital j in year t: sector, equipment level, and university status;

- V_{ijt} is the set of variables concerning hospital organization: the 24-hour availability of obstetricians for hospital j in year t, the day of delivery for woman i in hospital j in year t, the size of the unit based on the volume of deliveries of hospital j in year t, and the numbers of midwives, of obstetricians, and of anesthetists working at hospital j in year t, as measured by full-time equivalent (FTE) employees per occupied patient bed;[11]

- e_{ijt} is the error term.

We use hierarchical data: patients grouped by their hospitals. We estimate multilevel logit models with the robust variance that takes the lack of independence between observations at the hospital level into account. The Hausman specification test between the specifications of the hospital fixed-effects and the hospital random-effects results in accepting the null hypothesis (p-value > 0.10). The hospital random-effects model thus produces consistent and

[11] The amount of time independent private practitioners spend on their hospital practice is not known. As a result, we suggest that part-time private practice doctors work 50% of the time at the hospital, and thus represent 50% of a FTE. This standard assumption is widely used (Clark and Milcent, 2011). While this is perhaps reasonable, we also check that all our results are robust to the more extreme assumptions of 25% and 75% of a FTE (see Section 5.4).

efficient estimations: the hospital's characteristics not explicitly taken into account in the model are not correlated with any independent variables.[12]

5. Results

5.1. Patient and hospital factors

Table A2 in the Appendix reports the effects of the individual and hospital control variables on the probability of cesarean deliveries. Among the demographic characteristics, as expected, age and nulliparity increase this probability. Also as expected, well-known obstetric risk factors affect mode of delivery. Cesarean delivery is most prevalent for at-risk patients compared with those women who are at low risk. A non-vertex fetal presentation or transverse lie, previous cesarean, and placental disorder are the strongest risk factors.

Socioeconomic characteristics that increase a woman's probability of cesarean birth include no postsecondary education, compared to more highly educated women. Similarly, women in low-skill jobs, such as manual workers, or office, sales, and service workers, or a middle-skill job, such as workers with intermediate occupations, are more likely to have a cesarean delivery than those with high-skill jobs, for instance, managerial or higher intellectual professionals. If the woman is unemployed, her probability of a cesarean delivery increases. Moreover, women not living with a partner are less likely to have a cesarean than women with a partner. The same is true for the partner's socioeconomic characteristics: low-skill occupations increase the probability of cesarean delivery, compared to high-skill professional positions. Accordingly, the probability of cesarean is higher for women whose partners are not in the labor force, compared with those who work.

Hospital factors checked as control variables include neonatal equipment level; maternity units with neonatal care, versus those with no special neonatal care, have an increased probability of cesareans. Giving birth on a non-working day is negatively associated with cesarean delivery. Since many cesareans can be planned ahead, surgical deliveries are more likely to take place on working days.[13] Study of medical staffing levels shows that the more obstetricians per patient bed, the less likely a delivery by cesarean.

[12] We also use the hospital fixed-effects model as a robustness check. See more details in Section 5.4.
[13] When we focus only on unplanned deliveries, the effect of delivering on a non-working day is no longer significant. Results are available upon request.

In summary, different individual and institutional characteristics are significant indicators of cesarean deliveries. Our results are in accordance with the findings from the literature.[14]

Moreover, we tested for a linear time trend for the seven-year period to identify any patterns of incidence for cesarean deliveries over the 2008-2014 period. Taking into account all the factors, we observe a non-significant global trend.

5.2. Hospital sector

Table 2 presents the effects of hospital sector on women's probability of cesarean delivery. Column 1 of Table 2 shows that, after controlling for age, parity, and medical risk factors, admission to a private, compared with public, hospital increases the probability of cesarean delivery. Next, in addition to these epidemiologic factors, we consider socioeconomic factors in column 2 and find that private hospitals still have a higher rate of cesarean deliveries. In column 3, we also control for the hospital's type and organization and show that, all else being equal, giving birth in a private hospital substantially increases the probability of cesarean delivery. Computing the average partial effects estimates, we find that the probability of cesarean delivery rises by 7.6 percentage points in a private versus a public hospital.

[Insert Table 2]

We now investigate the pure impact of the supplementary private insurers on the sector's difference in probability of cesarean delivery. With hospital reimbursement under DRG-based payment for both sectors, the incentive for healthcare delivery appears to be similar regardless of the hospital. However, the DRG fee covers all expenses for giving birth in a public hospital, whereas in addition to the DRG fee, private hospitals receive additional payment from the woman and reimbursed to her by the supplementary private insurers. Nevertheless, other incentives may explain these differences in cesarean rates: malpractice liability and women's preferences.

First, we focus on malpractice liability. A cesarean birth may cause increased and perhaps unnecessary morbidity to a woman, as it is major surgery. However, when a woman has a medical risk factor, a cesarean can be a defensive act to prevent complications during

[14] As shown above in more details in Section 2.1.

delivery. Obstetricians may be protecting themselves from malpractice litigation. This defensive medicine choice does not come into play for women at low risk. When we compute the effect of hospital sector on the cesarean rate using each of the two subsamples thus defined and compare the results, we capture behavior due to self-protection against malpractice liability. Table 3 presents the sector effect on the use of cesarean deliveries for both the high and low medical risk subgroups, in columns 1 and 2, respectively. The high medical risk subgroup includes all women with at least one medical risk factor while the low medical risk subgroup only includes women without any medical risk factor. Regardless of other observed factors and of woman's degree of risk, private hospitals perform more cesarean deliveries than public hospitals do.

[Insert Table 3]

Another factor may be the women's preferences. In private hospitals, a woman chooses her own obstetrician, who will provide her prenatal care and be present for her child's birth. The relationship between the patient and the obstetrician is accordingly closer than in a public hospital where women do not see the same physician continuously throughout pregnancy. We assume that if the woman has a preference for a cesarean delivery, the obstetrician will plan it.[15] We then assess the effect of hospital sector on both planned and unplanned cesarean deliveries. Unplanned cesareans include those for which the woman expresses no known preference in advance. This subsample may also include all deliveries for which the obstetrician did not express her/his own advance preference for a cesarean delivery. Indeed, obstetricians may perform a cesarean based on their own preferred mode of delivery and their close relationship with their patients may allow them to convince these women. Columns 3 and 4 of Table 3 display respectively the results of the sector effect on planned and unplanned cesarean deliveries. Holding all other covariates constant, we find that the hospital sector effect is still substantial for both planned and unplanned cesarean deliveries.

5.3. Supplementary private health insurance

After adjusting for all variables including epidemiologic, socioeconomic, institutional, and organizational factors and restricting our analysis to unplanned cesarean deliveries, i.e., those for which the women is not known to have expressed any preference for a cesarean, and to the

[15] The data available here do not allow us to know the woman's preference. This assumption seems reasonable to us.

low-risk population, i.e., women for whom defensive medicine is not relevant, we find that hospital sector remains an independent factor for cesarean delivery (column 5 of Table 3). This finding shows that, besides the effect of the other potential factors, the compensation scheme matters strongly in procedure choice.

Table 3 also reports the average partial effects of hospital sector on cesarean deliveries for different subgroups of women. When a woman at high medical risk gives birth in a private versus public hospital, her probability of a cesarean increases by 10 percentage points (column 1). For low-risk women with an unplanned delivery (column 5), on the other hand, selecting a private hospital for delivery still increases their probability of a cesarean delivery by 3.6 percentage points. Therefore, we show that hospital managers and physicians respond to financial incentives introduced by private health insurance reimbursement. However, we also show that the difference in the compensation schemes does not explain the total disparity between sectors. Indeed, we find 4 percentage points of difference for private versus public hospitals between the group of all women (column 3 of Table 2) and the subgroup of low-risk women with unplanned cesareans (column 5 of Table 3), which we explain by other factors including physicians' practice of defensive medicine and women's preferences.

If the underlying explanation for the higher rate of cesarean deliveries in private compared with public hospitals is financial, based on the additional room and board payment and the physicians' additional fees, this higher rate should differ according to the work status of the woman and her partner. First of all, we check that regardless of the occupation of both parents, private hospitals perform more cesarean deliveries than public hospitals.[16] This result can be explained by the French context: 95% of individuals are covered by supplementary private health insurance, for which they, their employer, or their partner's employer pay.[17] Based on this result, we assess the work status of the women. The probability that non-working women with a non-working partner are covered by private health insurance is very low. They are expected to have difficulty paying these additional fees. Table 4 presents the results. The literature reports that low-income women have higher rates of cesarean deliveries.[18] Here, we also find that this subgroup of women with low socioeconomic status is the group most at risk of cesarean delivery regardless of the sector. However, focusing on the

[16] Tables of these results are upon request.
[17] Since 2015, but not during the period covered by the database used in this study, French law has required that employers provide workers with supplementary private insurance.
[18] More details are given above in Section 2.1.

private-sector effects on cesarean delivery according to the work status of both parents shows that the higher cesarean rate in private hospitals affects all women, except those who are not working and who have a partner who is not working. This result is very strong. That is, there is no difference in the cesarean rate between sectors for women who cannot afford to pay for a cesarean delivery and lack insurance for it — and only for them. Therefore, this finding confirms that the additional fees in the private sector are a real financial incentive to perform cesarean deliveries and may therefore explain the disparity we observe in the mode of delivery between the two sectors.

[Insert Table 4]

5.4. Robustness checks

In this paper, we control for unobservable hospital heterogeneity by using hospital random-effects. The Hausman test validated this econometric approach. As a robustness check, we present the results by using hospital fixed-effects. A strict collinearity exists between the hospital fixed-effects and the invariant explanatory variables at the hospital level. We therefore use a two-step fixed-effects model. In the first step, we regress the dependent variable (Y) on the observable variables at the woman's level, including demographic (D), medical (X), and socioeconomic (S) characteristics, as well as the indicators of the hospital fixed-effects crossed with the year dummies. In a second step, we explain these fixed-effects estimates by the trend (T), the hospital type variables (W), and the hospital organization variables (V).[19] Clustered standard errors of the second stage are estimated by bootstrap due to the use of an estimated dependent variable. The results using the hospital fixed-effects specification are very similar to the previous findings based on hospital random-effects specification (Table A3).

Second, our dataset covers the entire population of women who gave birth in the Yvelines over the period of 2008-2014. Because household socioeconomic information is not available for all observations, the analyses we present use all observations with complete socioeconomic data that enable us to control for all socioeconomic characteristics. To verify the lack of bias of this sample, we re-estimate all the models by using the full set of observations without taking socioeconomic information into account. The results, using

[19] As it is available at the individual level, the day of delivery variable is included in the first stage of the hospital fixed effects specification model.

hospital random- or fixed-effects, are similar to those based on our main sample (Table A4). The descriptive analysis further supports this finding that the distribution for the variables in the whole population and the main sample of analysis are almost identical.

Lastly, to treat the heterogeneity between public and private hospitals concerning information about hospital staff, we consider an average situation in which independent physicians working part-time devote 50% of their time to their hospital work. To verify that this hypothetical weighting does not affect our results, we test two extreme cases: a so-called minimal level of work in which they devote only 25% of their time to the hospital and a so-called maximal level of work, obtained by applying a coefficient of 0.75 to the total. These 25% and 75% extreme weightings for hospital work time of private physicians produce results similar to those based on the average weighting.[20]

6. Conclusion

Different characteristics of the healthcare market may drive costly health behaviors. One of them is the hospitals' mode of financing. Payments to hospitals may result in financial incentives that may encourage healthcare providers, including hospitals and the physicians they employ, to perform some medical interventions rather than others. Most developed countries have recently adopted activity-based payment systems for the purpose of improving hospital efficiency as well as the quality and effectiveness of care. However, empirical evidence is scarce, except from the U.S.

Cesarean deliveries are among the most common surgical procedures and absorb large quantities of healthcare resources annually. They are also one of the medical practices studied most by economists because they are potentially responsive to a variety of economic forces including source of payment and financial incentives.

This study used previously unexplored delivery data from a French district to examine the effect of hospital sector — private versus public — on utilization of cesarean deliveries, in the context of a unique single-payer healthcare finance system. The empirical analysis reveals that, after controlling for a large number of determinants for individual- and hospital-level factors that may affect obstetric practices, the probability of a cesarean birth is higher in a private than a public hospital.

[20] Full tables of results are upon request.

Despite the apparent similarity of funding for the private and public hospital sectors under a unique payment system, private hospitals receive an additional payment from their patients for room and board, costs which are not reimbursed by the single-payer public health insurance. The fees are, however, covered by private supplementary health insurers that help make care affordable for all patients regardless of whether it is public or private, and whether the delivery is cesarean or vaginal. But private supplementary health insurers disturb the public regulation set up by the reimbursement system of the single-payer public health insurance system. Specifically, the private health insurance affects medical practices in a market-driven public healthcare delivery system, including by creating incentives for harmful practices. These private health insurance policies and choices may affect or prevent the implementation of public policies developed by policy makers for the welfare of the society.

This result may be applicable abroad to other healthcare systems, for instance, the development of private medical insurance in addition to the National Health Service and Medigap policies in addition to classic Medicare. These forms of public healthcare funding, whether they are intended for all (France, U.K.) or for some (Medicare in the U.S.), have been set up with the objective of addressing inequity in access to healthcare. However, the development of the portion of medical care supported by supplementary private health insurance may impair this social goal of equity.

7. Bibliographic references

Allen, V. M., O'connell, C. M., Farrell, S. A., Baskett, T. F. (2005). Economic implications of method of delivery. American journal of obstetrics and gynecology, 193(1), 192-197.

Althabe, F., Sosa, C., Belizán, J. M., Gibbons, L., Jacquerioz, F., Bergel, E. (2006). Cesarean section rates and maternal and neonatal mortality in low-, medium-, and high-income countries: an ecological study. Birth, 33(4), 270-277.

Baker, L. C., Bundorf, M. K., Kessler, D. P. (2014). Vertical integration: hospital ownership of physician practices is associated with higher prices and spending. Health Affairs, 33(5), 756-763.

Barbetta, G. P., Turati, G., Zago, A. M. (2007). Behavioral differences between public and private not-for-profit hospitals in the Italian national health service. Health economics, 16(1), 75-96.

Biørn, E., Hagen, T. P., Iversen, T., Magnussen, J. (2003). The effect of activity-based financing on hospital efficiency: a panel data analysis of DEA efficiency scores 1992–2000. Health care management science, 6(4), 271-283.

Biørn, E., Hagen, T. P., Iversen, T., Magnussen, J. (2010). How different are hospitals' responses to a financial reform? The impact on efficiency of activity-based financing. Health care management science, 13(1), 1-16.

Borden, J. P. (1988). An assessment of the impact of diagnosis-related group (DRG)-based reimbursement on the technical efficiency of New Jersey hospitals using data envelopment analysis. Journal of Accounting and Public Policy, 7(2), 77-96.

Brown, H. S. (1996). Physician demand for leisure: implications for cesarean section rates. Journal of Health Economics, 15(2), 233-242.

Chern, J. Y., Wan, T. T. (2000). The impact of the prospective payment system on the technical efficiency of hospitals. Journal of Medical Systems, 24(3), 159-172.

Clark, A. E., & Milcent, C. (2011). Public employment and political pressure: The case of French hospitals. Journal of Health Economics, 30(5), 1103-1112.

Cleary, R., Beard, R. W., Chapple, J., Coles, J., Griffin, M., Joffe, M., Welch, A. (1996). The standard primipara as a basis for inter-unit comparisons of maternity care. BJOG: An International Journal of Obstetrics & Gynaecology, 103(3), 223-229.

David, S., Mamelle, N., Rivière, O. (2001). Estimation of an expected caesarean section rate taking into account the case mix of a maternity hospital. Analysis from the AUDIPOG Sentinelle Network (France). BJOG: An International Journal of Obstetrics & Gynaecology, 108(9), 919-926.

Dismuke, C. E., Sena, V. (1999). Has DRG payment influenced the technical efficiency and productivity of diagnostic technologies in Portuguese public hospitals? An empirical analysis using parametric and non-parametric methods. Health care management science, 2(2), 107-116.

Dubay, L., Kaestner, R., Waidmann, T. (1999). The impact of malpractice fears on cesarean section rates. Journal of health economics, 18(4), 491-522.

Ecker, J. L., Chen, K. T., Cohen, A. P., Riley, L. E., Lieberman, E. S. (2001). Increased risk of cesarean delivery with advancing maternal age: indications and associated factors in nulliparous women. American journal of obstetrics and gynecology, 185(4), 883-887.

Eggleston, K., Shen, Y. C., Lau, J., Schmid, C. H., Chan, J. (2008). Hospital ownership and quality of care: what explains the different results in the literature?. Health economics, 17(12), 1345-1362.

Fabbri, D., Monfardini, C. (2008). Style of practice and assortative mating: a recursive probit analysis of Caesarean section scheduling in Italy. Applied Economics, 40(11), 1411-1423.

Fuglenes, D., Øian, P., Kristiansen, I. S. (2009). Obstetricians' choice of cesarean delivery in ambiguous cases: is it influenced by risk attitude or fear of complaints and litigation?. American journal of obstetrics and gynecology, 200(1), 48-e1.

Gibbons, L., Belizan, J. M., Lauer, J. A., Betran, A. P., Merialdi, M., Althabe, F. (2012). Inequities in the use of cesarean section deliveries in the world. American journal of obstetrics and gynecology, 206(4), 331-e1.

Grant, D. (2009). Physician financial incentives and cesarean delivery: new conclusions from the healthcare cost and utilization project. Journal of health economics, 28(1), 244-250.

Gruber, J., Owings, M. (1996). Physician financial incentives and cesarean section delivery. The Rand Journal of Economic, 27(1), 99-123.

Gruber, J., Kim, J., Mayzlin, D. (1999). Physician fees and procedure intensity: the case of cesarean delivery. Journal of health economics, 18(4), 473-490.

Hafsteinsdottir, E. J. G., Siciliani, L. (2010). DRG prospective payment systems: refine or not refine?. Health economics, 19(10), 1226-1239.

Hammond, J. A. (2015). Does the presence of learners affect family medicine obstetric outcomes?. Canadian Family Physician, 61(11), e504-e508.

Herwartz, H., Strumann, C. (2014). Hospital efficiency under prospective reimbursement schemes: an empirical assessment for the case of Germany. The European Journal of Health Economics, 15(2), 175-186.

Hyde, M. J., Modi, N. (2012). The long-term effects of birth by caesarean section: the case for a randomised controlled trial. Early human development, 88(12), 943-949.

Le Ray, C., Carayol, M., Zeitlin, J., Breart, G., Goffinet, F., PREMODA Study Group. (2006). Level of perinatal care of the maternity unit and rate of cesarean in low-risk nulliparas. Obstetrics & Gynecology, 107(6), 1269-1277.

Linna, M. (1999). Health care financing reform and the productivity change in Finnish hospitals. Journal of Health care finance, 26(3), 83-100.

Linton, A., Peterson, M. R., Williams, T. V. (2004). Effects of maternal characteristics on cesarean delivery rates among US Department of Defense healthcare beneficiaries, 1996–2002. Birth, 31(1), 3-11.

Mazzoni, A., Althabe, F., Liu, N. H., Bonotti, A. M., Gibbons, L., Sánchez, A. J., Belizán, J. M. (2011). Women's preference for caesarean section: a systematic review and meta-analysis of observational studies. BJOG: an international journal of obstetrics & gynaecology, 118(4), 391-399.

Menacker, F., Declercq, E., Macdorman, M. F. (2006). Cesarean delivery: background, trends, and epidemiology. In Seminars in perinatology, 30(5), 235-241.

Milcent, C., Rochut, J. (2009). Hospital Payment System and Medical Practice. Revue économique, 60(2), 489-506.

Milcent, C., Zbiri, S. (2018). Prenatal care and socioeconomic status: effect on cesarean delivery. Health economics review, 8(1), 7.

Ministry of Health (2016). La complémentaire santé: acteurs, bénéficiaires, garanties. Panoramas de la DREES-Santé, 102.

Penn, Z., Ghaem-Maghami, S. (2001). Indications for caesarean section. Best practice & research Clinical obstetrics & gynaecology, 15(1), 1-15.

Rogers, A. J., Rogers, N. G., Kilgore, M. L., Subramaniam, A., Harper, L. M. (2017). Economic Evaluations Comparing a Trial of Labor with an Elective Repeat Cesarean Delivery: A Systematic Review. Value in Health, 20(1), 163-173.

Roman, H., Blondel, B., Bréart, G., Goffinet, F. (2008). Do risk factors for elective cesarean section differ from those of cesarean section during labor in low risk pregnancies?. Journal of perinatal medicine, 36(4), 297-305.

Sloan, F. A. (2000). Not-for-profit ownership and hospital behavior. Handbook of health economics, 1, 1141-1174.

Sommersguter-Reichmann, M. (2000). The impact of the Austrian hospital financing reform on hospital productivity: empirical evidence on efficiency and technology changes using a non-parametric input-based Malmquist approach. Health Care Management Science, 3(4), 309-321.

Souza, J. P., Gülmezoglu, A. M., Lumbiganon, P., Laopaiboon, M., Carroli, G., Fawole, B., Ruyan, P. (2010). Caesarean section without medical indications is associated with an increased risk of adverse short-term maternal outcomes: the 2004-2008 WHO Global Survey on Maternal and Perinatal Health. BMC medicine, 8(1), 71.

Villar, J., Carroli, G., Zavaleta, N., Donner, A., Wojdyla, D., Faundes, A., Velazco, A., Bataglia, V., Langer, A., Narváez, A., Valladares, E., Shah, A., Campodónico, L., Romero, M., Reynoso, S., de Pádua, K. S., Giordano, D., Kublickas, M. (2007). Maternal and neonatal individual risks and benefits associated with caesarean delivery: multicentre prospective study. Bmj, 335(7628), 1025.

Widmer, P. K. (2015). Does prospective payment increase hospital (in) efficiency? Evidence from the Swiss hospital sector. The European Journal of Health Economics, 16(4), 407-419.

Yang, Y. T., Mello, M. M., Subramanian, S. V., Studdert, D. M. (2009). Relationship between malpractice litigation pressure and rates of cesarean section and vaginal birth after cesarean section. Medical care, 47(2), 234.

Yee, L. M., Liu, L. Y., Grobman, W. A. (2017). Obstetrician call schedule and obstetric outcomes among women eligible for a trial of labor after cesarean. American journal of obstetrics and gynecology, 216(1), 75-e1.

Tables

Table 1. DRG fees for stays including childbirth by hospital sector.

	2008		**2014**	
	Public	Private	Public	Private
No complication				
Vaginal delivery (Euros)	2,164	1,450	2,439/2,054	1,490/1,282
Cesarean delivery (Euros)	2,983	1,789	2,812	1,759
Difference (%)	**+38%**	**+23%**	**+15%/+36 %**	**+15%/+37%**
Minor complication				
Vaginal delivery (Euros)	2,615	1,631	2,900/2,336	1,669/1,435
Cesarean delivery (Euros)	4,208	2,202	4,153	2,891
Difference (%)	**+61%**	**+35%**	**+43%/+77%**	**+73%/+101%**
Major complication				
Vaginal delivery (Euros)	3,347	1,803	3,071/2,615	1,803/1,617
Cesarean delivery (Euros)	4,900	2,346	4,383	2,967
Difference (%)	**+46%**	**+30%**	**+43%/+67%**	**+65%/+83%**

Note: Stays presented are those for singleton deliveries. For 2014, fees vary between nulliparous and multiparous women who deliver vaginally and are reported in that order.
Data source: French technical agency for hospital information (the *Agence Technique de l'Information sur l'Hospitalisation,* ATIH), 2008-2014.

Table 2. Effects of hospital sector on cesarean deliveries. Multilevel logit models (coefficient and average partial effects estimates).

	1	2	3
Coefficient estimates:			
Trend	0.003	0.002	0.001
	(0.014)	(0.015)	(0.013)
Private	0.418***	0.460***	0.582***
	(0.117)	(0.120)	(0.168)
Average partial effects estimates:			
Private	0.054***	0.059***	0.076***
	(0.015)	(0.015)	(0.023)
Demographic control variables	Yes	Yes	Yes
Medical control variables	Yes	Yes	Yes
Socioeconomic control variables	No	Yes	Yes
Hospital control variables	No	No	Yes
Observations (*N*)	58,645	58,645	58,645

Note: Robust standard errors clustered at the hospital level in parentheses. *** = 1% significance level, ** = 5%, * = 10%. All regressions use the main sample with complete socioeconomic data. Control variables include for demographics: age and parity; for medical risk factors: previous cesarean, diabetes, hypertension, eclampsia or preeclampsia, fetal growth restriction, placental disorder, other obstetric pathology, plurality, term at delivery, fetal presentation, induced labor, and birth weight; for socioeconomic status: woman's status of the couple, education, occupation, and work status, and her partner's occupation and work status; and for hospital characteristics: equipment level, teaching status, obstetrician availability, day of delivery, size, and numbers of full-time midwives, obstetricians, and anesthetists per occupied bed.
Data source: PCS, SAE, Yvelines district (France), 2008-2014.